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A note on some of the Scientific
Studies undertaken by members
of the Colonial Medical Service
during the period 1930-47, with
a Bibliography.



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A NOTE ON SOME OF THE SCIENTIFIC STUDIES UNDERTAKEN
BY MEMBERS OF THE COLONIAL MEDICAL SERVICE DURING
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A NOTE ON SOME OF THE SCIENTIFIC STUDIES UNDERTAKEN BY MEMBERS OF THE COLONIAL MEDICAL SERVICE DURING THE PERIOD 1930-1947, WITH A BIBLIOGRAPHY

Introductory

1. Although general accounts of the trends of medical research in the colonies were compiled for departmental use in 1928 and 1930,* the contributions of colonial service workers as a class have not received any special consideration in recent years. It is felt that a review of some of the lines of investigation followed during the period 1930-1947 will be of interest and value, as many original observations were recorded.

2. A survey of the literature shows that the Colonial Medical Service has provided a steady flow of papers over a fairly wide field. Thus, to take only two journals, the Transactions of the Royal Society of Tropical Medicine and Hygiene contained 157 papers by serving officers during the period under review, while the East African Medical Journal contained 494 papers. When the investigations recorded in other journals and in reports to Governments are also considered, the total volume of contributions is seen to be far from negligible. Naturally, these records vary a good deal in scientific importance, but some of them have led to notable advances in medical knowledge.

3. It is not uncommonly assumed, and with some justice, that the conditions under which medical inquiries have to be conducted in the colonies make it difficult to obtain fundamental information about disease. Laboratory facilities are limited, expensive apparatus is scarce, while practice of the more refined techniques is necessarily restricted to a small number of centres. Moreover, colonial territories cannot yet afford to employ more than a fraction of the number of fully qualified medical workers who are needed, and these men have to spend most of their time dealing with problems of a magnitude seldom encountered outside the tropics. But in spite of conditions which do not favour organised research it has been possible to provide valuable data in many branches. Advances in the understanding of natural phenomena depend upon the availability of measurable facts about them, and the chief source of such information is the field worker. In the medical sphere, such observations are particularly indispensable; for the science of medicine has to be built upon data which have been sought and found in the living bodies, habitations, and working places of men, and in the places frequented by parasites and insect vectors. The examination of dead tissues, isolated cultures, and insect colonies, and experimental infections, aided by precise laboratory methods, is of great importance. But detached studies and experiments, although they may provide clear-cut results in the presence of a reduced number of variables, cannot stand alone. Argument by analogy is not fully valid in the sphere of biology, and a final judgment on natural events must wait upon the statistician's analysis of vital data—the last word must come from the records of happenings in the field. This is often overlooked. Laboratory experiment has its renowned place, but the essential part played by the field worker should not be forgotten. His data provide important material for the scientific imagination, reflecting as they do the inherent variability of biological events.

4. Although few colonies are able to provide staff and facilities for full-time research, many valuable records have been furnished by officers engaged in routine clinical, laboratory, and preventive duties. The greater number of

* Memorandum on Medical Research in the Colonies (1928).

Memorandum on Medical Research in the Colonies, Protectorates and Mandated Territories (1930).

these records occur in departmental papers dealing with specific local problems; thus, some of the most valuable information on trypanosomiasis is to be found in the Annual Medical Reports of the African territories.

5. This review is intended to indicate the variety of subjects which have been investigated, and it is not proposed to do more than refer briefly to some of the more significant observations recorded. Little mention will be made of papers dealing with therapeutic and prophylactic trials of drugs (many of which are necessarily repetitive), and of clinical records which seem to be of restricted interest. It will be remembered, however, that data contained in such papers often provide a basis for the development of local medical policy.

6. An examination of the literature was greatly facilitated by Dr. C. Wilcocks, Director of the Bureau of Hygiene and Tropical Medicine, and by Dr. J. F. Corson, O.B.E., late Assistant Director of the Bureau, who kindly provided many of the references contained in this note. The Tropical Diseases Bulletin and Bulletin of Hygiene have been freely consulted. Finally, it should be explained that the note and bibliography include references to papers by scientific officers who, although not belonging to the unified Colonial Medical Service, were members of the staff of colonial medical departments; also, that references are made to papers in which Colonial Service Officers collaborated with workers who were not themselves members of the Service.

Nutrition and Deficiency Diseases

7. In 1930, disorders of nutrition were beginning to receive increasing attention, particularly in territories where it was suspected that many members of the population were suffering from a state of chronic undernourishment. The clinical syndromes of certain vitamin deficiency diseases had been recognised for years, but the lack of precise knowledge regarding the chemical nature of the vitamins and failure to recognise the implications of various clinical signs and symptoms had retarded a systematic approach. Nevertheless, some useful investigations had been carried out, and workers in many territories were on the look-out for specific signs of defective food intake.

8. One of the most fundamental studies carried out during the period under consideration was that of Orr and Gilks (1931), in Kenya. These workers made a detailed examination of two tribes whose dietary habits were in marked contrast, and found that it was possible to correlate these habits with differences in physical development and susceptibility to disease. This classical study provided important information regarding the constituents of a balanced diet. About the same time, other workers in East Africa were taking an interest in vitamin deficiency states. Buchanan (1932) in British Somaliland recorded the occurrence of a condition known locally as "chachaleh", now known to be one of the group of disorders associated with lack of the Vitamin B complex; a prominent feature of this syndrome was "burning feet", a form of paraesthesia which was later to become common among inmates of internment camps in the Far East. Uganda workers were more concerned with Vitamin A deficiency, which had begun to affect prisoners whose diet had been previously regarded as adequate. It was found possible to correct the deficiency by ensuring a minimum consumption of sweet potato, but the experience had stimulated interest in the underlying mechanism. A study by Owen and Hennessey (1932) showed that liver disease could cause the most severe ophthalmic manifestations of Vitamin A deficiency, apparently by interfering with carotene metabolism; it was also shown experimentally (Hennessey (1932)) that the anti-infective action of the vitamin was unrelated to the mobilisation of leucocytes. The skin changes associated with Vitamin A deficiency were studied by Loewenthal, who in 1933 published a valuable account of the follicular condition known as Phrynoderma; at this time, he and

others concluded that Phrynoderma was pathognomic of Vitamin A deficiency, but it is now recognised that it may have other causes.

9. In the Gold Coast, a peculiar syndrome occurring in malnourished infants was described by Williams (1933), while a similar condition was described by Gillan (1934) in Kenya. This syndrome, which is now known widely under its West African name of "Kwashiorkor", was characterised by skin and mucous membrane lesions, oedema, and gastro-intestinal disturbance. Although it was regarded by some workers as an infantile form of pellagra, there are grounds for attributing it to lack of more than one member of the Vitamin B complex, associated with "high carbohydrate-low protein" intake. Pellagra and allied conditions were also receiving attention in Nigeria, and the first of a series of careful reports on a local form of retro-bulbar neuritis was published by D. G. F. Moore in 1934. It soon became clear that this neuritis was related to pellagra, that it was associated with a cassava diet, and that it responded to treatment with marmite. It is now generally recognised as a manifestation of a B-complex deficiency, lack of nicotinic acid being the prominent feature.

10. A number of valuable investigations were carried out by Rosedale and his colleagues in Malaya. The results of an experiment to determine the effects of different proteins on growth were published in 1934, in which the superior value of animal protein was clearly demonstrated. In the same year Rosedale and Oliveiro recorded their assays of the fat-soluble vitamins of tropical food oils, the high Vitamin A content of red palm oil being a notable finding. The mineral content of a large number of tropical foodstuffs was determined by Morris and Rosedale (1935), who showed that quantitative variations were related to differences in soils, fertilisers, and methods of cultivation. Further analyses of local foodstuffs were published by Rosedale (1935), and a thorough survey of the whole subject of Malayan dietaries, with recommendations for the correction of defects, was contained in a paper by the same author which appeared in 1936. Rosedale (1939) investigated the nutritive value of rice, paying special attention to the effect of "polishing" upon protein and mineral content. In 1934, Simpson published studies relating to the polyneuritis which affects pigeons fed on polished rice, concluding that the condition was not caused by toxins ingested with the rice. An investigation of the carotene content of red palm oil was made by Simpson (1936); different testing techniques were compared, and the conditions affecting vitamin content were determined. Simpson (1939) also studied the effects of parboiling rice, showing the special value of this process where retention of thiamin is concerned.

11. Loewenthal (1935) in Uganda found a high incidence of Vitamin A deficiency among school children. The condition appeared to be related to the adoption of a one-crop policy. It was beginning to become clear that a large number of East Africans were subsisting upon diets which, although sufficient to prevent the occurrence of gross manifestations of malnutrition, were nevertheless inadequate for the development and maintenance of optimal function. Hennessey (1936) found that haemoglobin values among apparently healthy convicts in Uganda were markedly below those of healthy Europeans, while a degree of macrocytosis was common; it was thought at the time that the latter finding might be a physiological peculiarity of the East African native, but further work was to show that defective intake of the extrinsic substance required for efficient erythropoiesis was responsible (Trowell (1939)). Trowell (1937) published a study of a deficiency state occurring in Kenya children, which he believed to be pellagra. This was the first of a series of reports by this worker, in which he did much to elucidate the aetiology of the more obscure nutritional diseases of East Africa. His researches into the

anaemias encountered in Uganda led to a satisfactory classification, based on specific nutritional defects.

12. A monograph on nutritional disorders in the Gold Coast was published by Purcell in 1939. Although handicapped by lack of facilities for food analyses and other laboratory tests, he was able to define a number of clinical syndromes which were associated with malnutrition. Russell (1941) reported upon the occurrence of macrocytic anaemia in pregnant women in the same territory. She considered that this condition was related to diet and to malaria. The association of glossitis and dermatitis with nicotinic acid deficiency was noted by Purcell (1942).

13. In Tanganyika, investigations into nutritional states were made by McKenzie (1939) and by Young and Clark (1940); defective growth and signs of hypovitaminosis were found to be common among groups living on the customary local diets. These findings were supplemented by a valuable chemical analysis of Tanganyika foodstuffs published by Raymond (1941).

14. The whole question of macrocytic anaemia in Uganda was examined by Trowell (1939-40). In these papers, and in others published during the next five years, he reported upon the blood changes which are connected with dietary defects. He found that one of the commonest blood disorders among Uganda Africans was a mixed anaemia which he named "dimorphic anaemia", resulting from a combined inadequacy of iron and an extrinsic factor. The effect of liver extracts upon macrocytic anaemia was given critical attention. Trowell and Muwazi (1945) described a severe form of nutritional disease under the term "malignant malnutrition". This disease is characterised by a gross development of the changes first recorded by Williams (1933) in the case of "kwashiorkor", and appears to be associated with deficiencies both of protein and of the B-complex. On autopsy, extreme fatty changes and early cirrhosis in the liver, and proliferative glomerulitis in the kidney, are notable findings (Davies (1947)). Cirrhosis and glomerulitis had already been recorded among Africans dying from other causes (Vint (1931), Hennessey (1939), and Muwazi, Trowell and Hennessey (1942)), and it now appears likely that these chronic changes are due to malnutrition. It is interesting to note that certain disturbances of intestinal tone and motility, first demonstrated radiologically by Ross Golden in America, were present in cases of "kwashiorkor" studied in Uganda (Trowell and Scott Brown (1944)).

15. Among miscellaneous nutritional investigations carried out in other territories were a study of infantile beri-beri by Fehily (1941) in Hong Kong, in which she confirmed Japanese findings relating to changes in the milk secreted by malnourished mothers; a survey of deficiency conditions and dietary patterns in Bechuanaland by Squires (1941); an analysis of the relationship of tropical ulcer to nutritional defects in Nyasaland by Berry (1942); a study of the diet of the African soldier, showing the response to a balanced ration, by Anderson (1943); and a nutritional economic survey by Vickers (1944) in Palestine, in which dietary deficiencies at various expenditure levels were studied in urban and rural areas, and appropriate recommendations made for their correction.

Malaria

16. As was to be expected, the dominant place occupied by malaria as a cause of morbidity and mortality in the tropics gave rise to a large number of investigations. Most of the work was necessarily concerned with local aspects of the disease, for each territory has problems which are peculiar to its own particular kinds of environment. While advances in knowledge generally have a regional bearing, the variability of anopheline mosquitoes and malaria parasites makes it necessary to examine each new finding in relation to local

conditions. Thus, the behaviour of a vector species, the action of an insecticide, and the effect of a chemoprophylactic or chemotherapeutic drug must each be assessed for a particular region. This requirement is sometimes overlooked, and the precipitate adoption of measures found to be successful in one region has not infrequently led to undeserved criticism when an equivalent success was not obtained elsewhere. The above remarks explain the need for carefully recorded work in all territories, and for inquiries into the local validity of new findings.

17. In Malaya, which has been the scene of many important advances in this subject, Amies (1930) conducted chemotherapeutic investigations. He examined the effect of quinine and plasmoquin upon the gametocytes of *P. falciparum*, and demonstrated that plasmoquin had a strong lethal action. A study of the susceptibility to experimental infection of two local anophelines, *A. kochi* and *A. maculatus*, was published by Green and Gater in 1931; they found that *A. kochi* was actually the better carrier in the laboratory, although *A. maculatus* was more frequently found infected in the field. The same observers later made detailed investigations of the systematics and bionomics of the common Malayan anophelines (Gater (1933)), of the therapeutic effect of atabrin (Green (1934)), and of the relative merits of various methods of larval control (Green *et al.* (1933)). Comprehensive studies of the economics of malaria control in Malaya were published by Vickers *et al.* (1934), while important reports on the results of surveys and anti-larval measures came from Kingsbury and Scharff in 1935 and 1936.

18. In Kenya, Garnham (1931) studied the effect of quinine upon gametocyte production, while Symes (1931) published the results of entomological investigations in the Trans-Nzoia area, using precipitin tests to determine the feeding habits of local anophelines. Symes (1932) compared the effects of oil and Paris green against *A. gambiae* and *A. funestus*, and in the same year collaborated with Harvey in an investigation of the survival time of anopheline larvae in waters of varying avidity for oxygen. Garnham (1933) reported upon the characters of local strains of *P. falciparum*. Kauntze and Symes (1933) gave an account of an epidemiological and entomological investigation of malaria in a hyperendemic area (Taveta), with special reference to the immunity conferred by repeated infections during infancy.

19. Gibbins (1932) in Uganda examined the characters of local anophelines, and compared their infection rates under natural conditions. In 1933, he published complete records of domestic anophelines collected by him over a four-year period and followed these with studies of interrelationships between members of the *funestus* group (on the basis of egg characters), and of the qualities of oocyst pigment produced by the various species of malaria parasite.

20. Malaria problems in Tanganyika were extensively studied by the Wilsons and by Mackay from 1932 onwards. The significance of splenic enlargement as an indicator of the intensity of infection, and the characters of *P. ovale* in Tanganyika, were discussed in reports by the former workers in 1934 and 1935. In 1936, Wilson published an interesting account of hyperendemic malaria, in which he examined in detail the process of infection in babies. Meanwhile Mackay (1935) had published a report on the first two years' work of the Dar-es-Salaam Malaria Survey, containing important observations on local epidemiology and entomology, among which was an account of the development of *A. gambiae* in brackish water.

21. Conditions relating to malaria in British Guiana were examined by Giglioli (1932-33-38), whose researches into blackwater fever, nephritis caused by *P. malariae*, and the bionomics of *A. darlingi* are of special importance. Malaria in Trinidad and Tobago was investigated by de Verteuil (1933) who assessed the parts played by local anophelines and by varieties of *A.*

tarsimaculatus in particular, laying down principles of control. In Hong Kong, Jackson (1934-36) recorded investigations into the local factors bearing upon malaria, and gave comprehensive descriptions of entomological and other findings; precipitin tests were used in determining the feeding preferences of anophelines. About the same time, a classical account of the epidemiological and entomological aspects of the great Ceylon epidemic of 1934-35 was compiled by Briercliffe and other members of the Ceylon Service; this account contains important observations upon control methods, including the use of atabrin.

22. Work on hyperendemic malaria in Kenya was carried on by Garnham (1935), who showed that under certain conditions *P. vivax* could be a more dangerous species than *P. falciparum*. Garnham and Evans (1936) published a detailed ecological study of *A. funestus*, while Symes (1936) also recorded extensive observations upon this important vector. A comparison of the results of treatment with atabrin, plasmoquin and quinine was made by Carman and Cormack (1935-36).

23. In Tanganyika, the Wilsons (1937) gave an account of the relationship of immunity to frequency of infection; special attention was drawn to the value of the average parasite count at ages as an index of susceptibility under field conditions. These investigations were continued, and more extensive data relating to hyperendemic conditions were published in 1938. A comparison of two tribes living under different intensities of infection appeared in 1939, in which the evanescent nature of immunity resulting from exposure to *P. falciparum* was clearly demonstrated. A paper dealing with practical measures for the control of malaria on coffee estates was published in 1940.

24. A report on a Nigerian method of testing anti-larval compounds under standard conditions was published by Cauchi *et al.* (1936). In the Gold Coast, Russell (1938) reviewed her experience of the treatment of malaria in children. The relative importance of local anopheline species in Grenada and St. Lucia was studied by Earle (1936), who showed that *A. tarsimaculatus* was mainly responsible for malaria. Harkness and Samaha (1937) gave a valuable account of the use of explosives for anti-malarial drainage in Palestine, several thousand acres of swamp being eliminated at a cost much below that of any other available method.

25. In Malaya, the results of a survey of malaria in a rice-growing area (Kedah) were published by Vickers and Strahan (1936). The prophylactic action of atabrin in the field was investigated by Field, Niven and Hodgkin (1937), who made detailed studies of incidence and parasite rates under controlled conditions. Field (1937-38) published further accounts of chemotherapeutic work, and in collaboration with Niven (1938-39) assessed the results of drug control in Malayan estates. The classification of malaria parasites in thick blood films stained by a new technique was described by Field and Le Fleming (1939) and Field (1939); this was the first description of a method which has now become standard practice in most tropical laboratories.

26. An important study of the part taken by the placenta in anti-malarial immunity was carried out by Garnham (1938) in Kenya. His paper on the significant change in resistance which occurs when the abundant reticulo-endothelial tissue of the placenta is separated from the maternal circulation at parturition is the most comprehensive work on this subject which has so far been published. Garnham (1938) also gave a critical account of the epidemiology of malaria transmitted by *A. funestus* in Kisumu, where the imperfect correlation between anopheline density and seasonal changes in infection rate presents unusual features; in this paper the classification of varieties of *A. funestus* on the basis of tergal plate morphology is also discussed.

On the Kenya coast, a complete malaria survey of Mombasa was made by Symes *et al.* (1939).

27. The afforestation of swampy ground with species of eucalyptus was found to be a cheap and effective control measure in Uganda, and Hopkins (1940) described the results of this method in areas which were heavily infested with *A. gambiae* and *A. funestus*. Hopkins (1941) recorded an epidemic of malaria caused by *A. funestus* derived from a breeding place over two miles distant, and in the following year gave an account of the use of cotton-seed tar as a larvicide against *A. gambiae*.

28. A suspected new species of malaria parasite, for which the name *P. wilsoni* was proposed, was described by Roberts (1940) in Kenya. The validity of this species has not yet been confirmed.

29. In British Somaliland, Wilson and Notley (1943) published the first British report on the local malaria situation, giving the results of extensive entomological and epidemiological investigations. Symes and Hadaway (1945) in British Guiana designed and carried out one of the first experiments to assess the lethal effect of DDT on local anophelines. Different techniques of application, including the use of a DDT mist, were critically examined. Garnham (1945) in Kenya investigated an outbreak of malaria which occurred at an altitude of over 7,500 feet, the vector being *A. gambiae*; in the affected area, the temperature in affected native huts during the cool season is just sufficient to permit sporogony to take place in mosquitoes sheltering within.

30. An important investigation into the bionomics of melanic varieties of *A. gambiae* was carried out by Chwatt (1945) in Nigeria. Extensive breeding experiments were performed, from which it was concluded that *A. melas* is a biological race which is physiologically adapted to a salt-water environment during the larval and pupal stages. Further researches on this subject were published by Gilroy and Chwatt (1945), who described important work in connection with the location and drainage of swamps in which *A. melas* breeds near Lagos. An account of experiments to determine the concentration of gametocytes necessary to infect anophelines was given by Robertson (1945), who provided quantitative data relating to the minimum infective dose of human blood which is required in order to produce oocyst formation. In the field of ecology, Hopkins (1936) published an important monograph on larval bionomics of mosquitoes of the Ethiopian region and the taxonomy of culicine larvae. This contribution has now become a standard work of reference.

Trypanosomiasis and Tsetse Flies

31. A large amount of original work on sleeping sickness has been carried out by officers of colonial medical departments, whose studies in East and West Africa have contributed greatly to modern knowledge in this field. Many important researches, particularly in regard to experimental chemotherapy, have been carried out in the various institutes of tropical medicine which have been set up in the United Kingdom and other European countries. But the complex relationship which exists between the tsetse fly, the trypanosome, and the zoological and botanical characters of any infected area has to be disentangled in the field itself. The appraisal of the components of the reaction in their natural state is essentially a task for long-term workers, many of whom have appeared among the ranks of Government officers. Such men have had notable success in the evolution of methods for the control of trypanosomiasis and for the reclamation of land which the tsetse had rendered uninhabitable for human beings and domestic stock. A comprehensive account of all the work carried out in this subject between 1932 and 1944 has been published by

Wilcocks *et al.* (1946), a monograph which forms an invaluable source of information on trends of research in colonial territories.

32. Some of the most outstanding work during the period under review took place in Nigeria. On the protozoological side, Lester (1933) examined the natural differences exhibited by trypanosomes, and found that a considerable range of variation occurred among strains collected from different localities; the characters studied were virulence, nuclear position, and resistance to tryparsamide and to human serum. Other studies (Lester (1932-33)) showed that acquired resistance to human serum *in vivo* did not render a trypanosome resistant *in vitro*. This worker also found that tolerance acquired by cattle did not always protect them against the dosage of trypanosomes to which they might be exposed when in the bush (Lester (1935)). Again, he showed (1931-34) that strains of *T. gambiense* which were naturally resistant to arsenicals occurred in areas where no treatment had been given. In further investigations, Lester tested the therapeutic value of several new compounds on a large scale, and an effective policy of drug control was finally evolved. Important studies of the diamidine compounds were made by McLetchie (1940) who found that stilbamidine was as effective as antrypol in early cases. Harding (1940) also reported on trials of stilbamidine in Nigeria, while Bowesman (1940) tested it in the Gambia. Saunders (1941) carried out a trial of pentamidine in the Gold Coast, in which he found that good results were obtainable in cases which were free from marked involvement of the central nervous system. Lester (1933-34) had found that treatment of *T. congolense* infections in cattle with Surfen C was effective, although this drug causes severe nephritis when used in man.

33. In East Africa, a number of important investigations were undertaken at the Human Trypanosomiasis Institute in Uganda, particularly with regard to the interrelationships of the *rhodesiense-brucei* group, the infectivity to man of *T. gambiense* maintained in animals, and the factors which influence cyclical transmission (Duke (1933-34-35-37)). Among other results, these experiments showed that passage through relatively uncongenial hosts was not sufficient to cause a change in the infectivity of *T. rhodesiense* where man was concerned. This subject was also studied by Fairbairn (1937) and Burt (1942) in Tanganyika, who conducted an elaborate series of experiments in animal passage. These workers, following Duke, used human volunteers, and confirmed the correlation of virulence with transmissibility and infectivity. Corson (1933-34-35-36-37-38-39) carried out exhaustive investigations into the variability of trypanosomes. He attempted to alter the characters of *T. gambiense* by passage through monkeys for a period of years, but found that the resulting changes in morphology and virulence did not survive subinoculation into other animals. Corson also found that the resistance of *T. rhodesiense* to human serum was not increased after passage through *G. morsitans*. An interesting finding recorded by this worker was a high rate of salivary gland infection in tsetse which had fed upon a certain species of bushbuck; this indicates the kind of factor which may lead to an increased incidence of infection in a particular environment. A detailed study of the pathology of human trypanosomiasis was made by Calwell (1937) in Tanganyika, who published an account of the microscopic changes produced during the various stages of central nervous system involvement. Lamborn and Howat (1936) observed chronic infections in Africans, and were able to infect dogs and rats both mechanically and cyclically with such strains. Studies of the red cell adhesion phenomenon were recorded by Duke, Wallace and Wormall (1930-31) in Uganda: the factors involved in the reaction were critically analysed, and it was shown that the underlying principle could be successfully applied in the diagnosis of human infections.

34. Duke (1934) investigated the prophylactic effects of Bayer 205 on human volunteers, and his findings have led to the extensive use of this drug for preventive purposes. A number of Uganda cases of *T. gambiense* infection were treated with pentamidine by Lawson (1942), who showed that this drug gave excellent results in the early stages of the disease.

35. In Mauritius, animal infections were the subject of inquiries by Adams (1935-36), using *T. evansi*, *T. vivax*, and *T. theileri*. It was found that tolerance to *T. vivax* developed readily in cattle, although the majority of sheep and goats died of acute infection.

36. The biology of the tsetse has been extensively studied in both East and West Africa. In the former, many important observations have been made by workers in non-medical departments, but the contributions of the medical branches have added considerably to an understanding of the basic factors. Nash (1933) in Tanganyika showed that the size of a population of *G. morsitans* is significantly affected by air dryness, and he later published detailed figures for the ranges of climatic factors within which this species of tsetse can survive (Nash (1937)). He also compared the races of *G. morsitans* found in Tanganyika and Nigeria, pointing out that a more extensive dispersal occurred in Tanganyika as a result of the longer rainy season, and that there are marked differences in the kinds of breeding places chosen in each territory. Studies of the biology of *G. submorsitans* were published by Nash (1937-39), in which he showed that the cycle of breeding habits was correlated with changes in vegetation, which in turn were determined by climatic factors. Nash's work on the bionomics of *G. palpalis* and *G. tachinoides* in Nigeria are of special interest, and methods of clearing based upon his climatological and plant-association researches are now in general use in that territory. These methods afford a practical means of creating a gap between man and the fly, and thus of creating an environment free from serious risk of attack by the trypanosome. In the Gold Coast, Morris (1932-34) has made useful observations on the ecology of local species of tsetse, and has developed a method of discriminative clearing which is stated to give good results. Symes and McMahon (1937) investigated the food hosts of *G. swynnertoni*, using the precipitin test; they found that the main blood sources in East Africa were bovids, giraffe and pig. The habitat of *G. palpalis* has shown some variability in recent years, and Chorley (1944) in Uganda found pupae of *G. palpalis fuscipes* as far as twelve miles from water, in dense humid forest broken by elephant tracks. Gibbins (1941) had shown that food supply was an important factor in determining the habitat of this species. (Symes and McMahon (*loc cit.*) noted that most of the tsetse studied by them on islands in Lake Victoria had fed on a host which they could not identify.) In the Gold Coast, Saunders and Morris (1932) examined the association of trypanosomiasis with different species of tsetse, concluding that although *G. palpalis* was by far the most important vector, infection might occasionally be transmitted by *G. longipalpis*. Morris (1932) found that *G. tachinoides* was the carrier of the pathogenic trypanosomes of cattle in the Northern Territories of the Gold Coast. Nash (1937) showed that the mean length of life of *G. tachinoides* and *G. submorsitans* in Nigeria was profoundly influenced by temperatures exceeding 100° F., and that maximum fly activity occurred between 81° and 85° F.

37. On the question of control, practical methods were worked out along different lines in West and East Africa. In the former, the existence of large areas with high infection rates made mass treatment an essential preliminary measure; treatment schemes were organised with great success and the Nigerian methods have been described in detail by Lester (1931-35). By these means it was possible to reduce the infection rate over the whole of Nigeria from about 20 per cent in 1935 to 2 per cent in 1943. Following the mass treatment,

clearing methods have been effectively used to reduce man-fly contact. In one area (Anchau), an extensive resettlement scheme was drawn up, in order to achieve a population density which would lead to exclusion of the tsetse; this project, which was executed with great care and forethought, has resulted in freedom from fly and in a striking betterment of social conditions. In East Africa, the epidemiological position favoured anti-fly operations and the establishment of controlled settlements. Promising results have been obtained by direct attack upon the vegetation associated with fly belts. Apart from the pioneer work of Swynnerton in the last-mentioned field, important papers on tsetse control methods have been published by Fairbairn (1937-43) and Maclean (1935) in Tanganyika, Symes (1935-37-38) in Kenya, and Brown (1938) and Gibbins (1941) in Uganda.

Plague

38. The endemicity of plague in East Africa has led to a series of laboratory and field investigations by workers in Kenya and Uganda. De Smidt (1930) examined various methods of vaccine manufacture in Kenya and succeeded in obtaining a product with high immunological potency. Symes and Hopkins (1932), also in Kenya, investigated the specific host preferences of rats and fleas in various districts, and discussed the part played by different species in the epidemiology of plague. Similar observations were made in the Lango district of Uganda by Barrett (1933), who paid particular attention to the flea-rat associations which were connected with the high prevalence of plague in cotton-growing areas. Hopkins (1935) studied the bionomics of rat fleas in Uganda, and showed that there was a close correlation between duration of life and atmospheric conditions. The association of rats with different types of buildings was examined in Kenya by Roberts (1936). The same worker published an account of a plague epidemic in Keruguya, in which he analysed the parts played by domestic and field rodents (Roberts (1936)). Roberts in the same year made a comprehensive study of the carriage of plague in Kenya, and discussed the conditions which determine the ability of the infection to become established in towns. Hopkins (1938) investigated the dissemination of plague along trade routes in Uganda and showed that, contrary to general opinion, there was no evidence in favour of the view that the transport of cotton was a source of danger. Roberts (1939) made an extensive examination of rat and flea conditions in an endemic plague area in Kenya, and found that the population density of *Rattus rattus* was the most important single factor. In Uganda, Hopkins (1941) recorded local experience of the use of Cyanogas for the de-ratting of huts; Burton and Hennessey (1940) noted the occurrence of a subacute form of plague; while Hennessey (1942) described changes in the pathology of pneumonic plague which suggested that local strains of *P. pestis* had undergone a loss of virulence in recent years. An epidemic of plague in Nairobi in 1942 provided an opportunity for comprehensive studies; papers dealing with the epidemiological, pathological, bacteriological and clinical features of this outbreak were published by Plum, Vint, de Smidt, Wright and Dowdeswell (1942). An important observation on this occasion was the success achieved with sulphonamides in the treatment of bubonic plague.

39. Outside East Africa, valuable reports on plague in Ceylon were published by Hirst (1930). Special attention was given to the use of cyanide in the disinfestation of ships, and to the rodent and entomological factors bearing upon plague at Colombo. In Malaya, Gilmour (1934) recorded statistics of rat and rat-flea densities at Singapore and discussed the influence of climatic variables upon the incidence of human plague. Uttley (1938) gave an account of the epidemiology of plague in Hong Kong. He examined the social conditions prevailing among the Chinese urban population, and included

a statistical analysis of death rates at ages and their association with climatic changes.

Tuberculosis

40. An investigation into the incidence of tuberculosis among the Arabs of Trans-Jordan was made by MacLennan (1935). A relatively high infection rate was found, and the local clinical and immunological features were reviewed. The effects of nutrition and the nomadic way of life were discussed in a very informative paper.

41. One of the most comprehensive surveys of tuberculosis yet made in the colonies was carried out by Wilcocks (1933-34-38-39) in Tanganyika. This worker made a detailed study of the epidemiological and clinical features of tuberculosis among urban and rural Africans. He classified the types of disease which were prevalent, and drew up a scheme of prevention and treatment. His work was continued by Davies (1938), who has described measures used in the control of the disease at Kibongoto: this account gives an interesting picture of the use of the tuberculin test, collapse therapy, and family contact examination in an African rural area.

42. The epidemiology of tuberculosis in Nigeria was reviewed by Young (1934), who was also responsible for bacteriological investigations into the local types of tubercle bacillus.

43. In British Guiana, Cochrane (1938) examined the local statistics of tuberculosis and recorded the results of postmortem examinations; he discussed forms of treatment, and emphasised the paramount importance of contact tracing. His paper included complete clinical and pathological data relating to the cases investigated.

44. Uttley (1938) published the result of an investigation into the tuberculosis position at Hong Kong. Statistics of incidence over a long period were given, and the economic associations of the disease were discussed. A similar study was carried out in Malaya by Poynton (1939), who found a high incidence of primary infection.

Leprosy

45. Most of the work carried out during the period under review has been concerned with incidence and treatment. In Nigeria, Davey (1938) gave an account of clinical and bacteriological findings recorded during a survey. Similar work has been carried out by other officers in the course of their duties, and the incidence of the disease in this territory is now fairly well assessed. In Fiji, Austin (1932) described his findings in children; the importance of family contact was clearly shown, more than 50 per cent of infected children having one or more infected relatives. A further report was published by Austin in 1936, reviewing the clinical manifestations and incidence of the disease, and noting the poor prognosis for cutaneous cases. Ryrie (1933-38) published a series of papers on his experiences in Malaya. He showed that certain dyes (trypan blue, brilliant green, etc.) had a therapeutic effect, but were less regular in their action than the chaulmoogra derivatives, Ryrie also reviewed the classification of leprosy in Malaya, and suggested that the standard formulae could be improved by the inclusion of symbols indicating the degree of resistance. (A system of this kind is now in use in some of the South American states.) He studied the treatment of tuberculoid leprosy by different methods, and showed that phthalic acid had a tendency to cause reactivation and retrogression of lesions. In the Solomons, Innes (1938) made a survey of leprosy. He found a high incidence in some areas, associated with defective diet and the presence of other infections. An important paper on the use of sulphone compounds in the treatment of leprosy was published by Wharton

(1946), whose experience in British Guiana confirms the outstanding value of this group of drugs.

Yellow Fever

46. Fundamental work on this disease has been undertaken by the Rockefeller Foundation's teams in colonial territories, and medical officers, pathologists and entomologists have on occasions co-operated in such investigations. In Nigeria, various aspects of the pathology, epidemiology and immunology of the disease were examined by Smith (1936-40-42).

Rabies

47. The most outstanding work carried out in any territory was that of Stuart and Krikorian in Palestine, whose papers dealt with a number of careful and significant investigations. In 1931, they described their method of preparing anti-rabic vaccine, and followed this with studies of the effects of different techniques of animal immunisation. Other reports were concerned with the significance of the rabicidal antibody-content of the serum as an index of acquired resistance, and with the factors associated with neuro-paralytic accidents.

In Trinidad, Pawan and Hurst (1931-32) gave illuminating accounts of the transmission of rabies by vampire bats. The disease had given rise to considerable mystification, and was generally believed to be a peculiar local type of spinal myelitis. After Pawan had deduced the true nature of the condition on epidemiological grounds, the part played by the bats was conclusively demonstrated by transmission experiments.

Typhus

48. The variety of rural typhus found in Malaya presented problems which stimulated an important series of studies by Lewthwaite, Savor, and other workers of the Institute of Medical Research. The first step was the elucidation of the relationship between this disease and the condition known as "tsutsugamushi" in Japan. Lewthwaite (1930) published an account of the epidemiology, and described the characters of experimental laboratory infections. In 1934 he reported upon investigations into the comparative immunology of the Japanese and Malayan forms of rural typhus, and showed by cross immunity tests that the antigenic components of the two viruses were identical. Lewthwaite (1936) then gave an account of the three local types of typhus, and in the same year discussed the detailed pathology of the rural variety. The virus of this disease was isolated from wild rats, and the variations in Weil-Felix titres found in experimental animals were analysed.

49. In East Africa, typhus seldom formed a serious public health problem, and until 1934 no outbreak of the louse-borne form had been recorded. An investigation of the first epidemic of classical typhus seen in Uganda was described by Hennessey (1934), who recovered the virus from the blood of human cases and from lice taken from patients: the infection was transmitted to guinea pigs, and the characteristic pathological and serological changes demonstrated. The existence in East Africa of a form of tick typhus had been suspected on clinical grounds for some years, and Roberts and Tonking (1933-35) in Kenya showed that the infection actually did occur, and that the vector was the dog tick *Rhipicephalus sanguineus*. The causative *Rickettsia* was found in ticks obtained from houses in which dogs were kept, and guinea pigs were infected by the inoculation of tick emulsions.

50. In Nigeria, Hughes and Baldwin (1942) gave an account of investigations into endemic typhus, concluding that the disease occurred as a sporadic infection resulting from attack by rat fleas transmitting *R. mooseri*.

Typhus in Northern Nigeria was the subject of a study by Findlay and Elmes (1947).

Helminthology

51. The high prevalence of schistosomiasis in Nyasaland has been noted for a long time, and a full account of the situation was given by Gopsill (1931-32). He examined 1,000 persons, and showed that the common intermediate host of *S. haematobium* in the lower Shire area was *Melanoides tuberculata*. Among other interesting findings, Gopsill noted an association between rectal schistosomiasis and certain eye lesions.

52. In Uganda, a peculiar eye condition known locally as "bung eye" was investigated by Owen and Hennessey (1932). The disease was characterised by recurring oedema. A high eosinophilia was invariably present, and sections of the nodules showed a worm which has not yet been identified; it is possibly an immature *A. perstans*. A dermatosis showing marked lichenification with pruritus had been noted in Uganda for many years, and the clinical and pathological changes were described by Fleming and Hennessey (1932). The disease was regarded as a form of helminthic infestation, although no worms could be found in the affected tissues; subsequent work by Loewenthal and Gibbins (1933) showed that the parasite concerned was *Onchocerca volvulus*, and that the vector was a species of *Simulium* which was breeding freely in the River Nile.

53. Adams (1933) described the first examples of human infestation with *Bertiella studeri* which had been encountered in Mauritius, and in 1934 and 1935 published important work on schistosomiasis in this island. He showed that the local snail host was *Bulinus forskali*, and completed the chain of evidence by infecting mice with cercariae derived from infected snails. Gebert (1937) investigated the transmission of filariasis in Mauritius, and found that *F. bancrofti* could complete its life cycle in *A. gambiae* and *A. funestus* as well as in *Culex fatigans*.

54. A clinical study of schistosomiasis in Kenya was made by Trim (1936), who found that cirrhosis and splenomegaly resulting from *S. mansoni* infection occurred in about 1 per cent of hospital patients. Dowdeswell (1938) gave a full account of experimental work on the transmission of schistosomiasis in the Kavirondo district of Kenya, showing that *B. forskali* was the intermediate host of *S. haematobium* and *P. nasuta* that of *S. bovis*. He made a comparison of molluscan species in infected and non-infected districts, showing differences which were connected with variations in incidence.

55. In Nigeria, Taylor (1932) recorded an outbreak of *S. mansoni* infestation in the Northern Territory, and found that *Plan. pfeifferi* and *Plan. stanleki* were the local intermediate hosts. Hicks (1932) in Sierra Leone investigated the transmission of *F. bancrofti*. Larvae were found in a number of wild anophelines, and the transmitting species were determined by experimental feeding on human cases. Ramsay (1932) recorded a survey of *S. haematobium* in Nigeria. The filariasis position in Ceylon was studied by Dessanayake (1939), who found an incidence of about 80 per cent of infection with *Mf. malayi* in the southern province, the transmitting insect being *C. fatigans*. Poynton and Hodgkin (1939) showed that *Macacus irus* in Malaya harboured a microfilaria resembling *Mf. malayi*, and were able to transmit this helminth experimentally by a *Mansonia* species. The occurrence of linguatulid infestation in man was reported from Nigeria by Cannon (1942).

56. The epidemiology of *Onchocerca volvulus* in the Kavirondo district of Kenya was discussed in a paper by McMahon (1940). The disease was found to be closely correlated with the presence of *Simulium neavei*, and this insect was proved to be the vector. An important advance in the control of

Simulium neavei was made by Garnham and McMahon (1947), who elaborated a simple and entirely successful technique for the application of DDT to infested streams, obtaining complete elimination.

Haematology

57. Before the period under review, few colonies possessed accurate knowledge of local varieties of anaemia, or even of the ranges of variability of the blood characters in healthy people. It was recognised that hypochromic anaemias were common in most territories, being generally attributed to hookworm infestation and defective iron intake. But little was known regarding the prevalence of the blood disorders which occur in temperate climates.

58. In East Africa, the existence of an anaemia which bore some resemblance to pernicious anaemia had long been noted, although the presence of gastric acid showed that the condition was not the typical European variety. A macrocytosis seemed to be frequently present in apparently healthy Africans. (Hennessey (1936).) Trowell (1938) reported a case of tropical macrocytic anaemia from Uganda, and similar cases were seen in Kenya by Anderson and Roberts (1940) and in the Gold Coast by Russell (1941). The first case of haemophilia believed to have been recorded in an African was investigated by Trowell (1941). The same worker published in 1939 an account of his experience in the diagnosis and treatment of the common anaemias of Uganda, with particular reference to corpuscular measurements and other cytological characters. He showed that macrocytic anaemia was not uncommon, and associated it with dietary deficiency. His investigations in this direction have already been noted in the section dealing with nutrition.

59. The phenomenon of sickling was investigated in Nigeria by Evans (1944), who gave a full account of the physical factors and compared results obtained by different techniques. He found an incidence of about 20 per cent in the 600 West Africans examined, and noted that there was a higher proportion of pathological manifestations of sickling when other diseases were present. An interesting study of erythroblastic anaemia of childhood (Cooley's anaemia) was made by Fawdry (1944) in Cyprus; he gave a detailed description of the clinical, radiological and haematological features of this obscure condition.

Blackwater Fever

60. The association between blackwater fever and quinine-taking was examined by Connal (1930) in Nigeria. He studied data collected over a period of thirty years, and concluded that quinine could not be regarded as a specific cause of the condition, although it was clearly related to the onset of haemolysis in many cases. There was a marked difference in incidence between quinine-takers and other subjects. In Nyasaland, Shelley (1931) made a careful analysis of the statistics over ten years; the association with subtertian malaria and anti-malarial measures, and the special susceptibility of immigrants, were distinctive features of the disease.

61. An illuminating discussion of the mechanism of blackwater fever was contained in a paper by Vint (1941). This observer examined the characteristics of the disease in the light of recent work on the splenic circulation and on the "stabilisation" of red blood cells. He concluded that the conditions found in the pre-blackwater state were essentially such as would lead to the sudden liberation of unstable erythrocytes from the splenic sinuses, with every prospect of a sudden haemolysis. The paper forms an important background to an understanding of the disease.

Neurology and Psychiatry

62. A fundamental study of the African brain was described in a paper by Vint (1934). This worker made a careful examination of the macroscopic and microscopic features of a large number of specimens, and noted that there were significant deviations from the European type characters. In particular, the frequent presence of a lunate sulcus and a relatively shallow cortex suggested that the brain of the African was in an evolutionary stage which differed from that reached by the European brain.

63. Trowell and Muwazi (1944) analysed the neurological cases seen by them in Uganda, and found that all the conditions encountered in temperate climates were represented. The high incidence of syphilitic meningoencephalitis was specially noted. In Kenya, Carothers (1947) gave an important account of his psychiatric observations, including a discussion of stresses imposed by a rapid transition from tribal to European forms of culture.

Pathology

64. A full account of cirrhosis of the liver in Kenya was given by Vint (1931). He described the pathological findings in a large number of cases, all of which showed the monolobular type of cirrhosis. The aetiology of the condition was discussed, and it was concluded that both dietary and helminthic factors were probably concerned. In Nigeria, Smith and Elmes (1934) published an analysis of 500 tumours; the various forms of neoplasm were described in relation to their tissues of origin, and the frequency of melanomata and primary hepatic carcinomata was noted. A similar survey was published by Vint (1935), who found that 23.8 per cent of tissues from Kenya Africans showed malignant changes, his findings being in close agreement with the Nigeria figures. An investigation of liver disease in Uganda was made by Muwazi, Trowell and Hennessey (1942), who provided clinical and pathological data relating to all cases of liver disease seen over a two-year period. They paid particular attention to the differentiation of toxic and infective hepatitis and to the pathology of cirrhosis and haemolytic jaundice. It was considered that the high frequency of primary hepatic carcinoma was related to the compensatory cellular proliferation associated with post-degenerative cirrhosis. Vint (1937) analysed the pathological findings in 1,000 autopsies on Kenya Africans, providing valuable data relating to the types and incidence of many, local and general diseases. The number of latent conditions, particularly tuberculosis, was remarkable. In Uganda, the prevalence of endotheliomata was discussed in a paper by Hennessey (1943) who found that this form of tumour represented some 8 per cent of all solid neoplasms seen by him; the condition was frequently related to inflammatory foci, which appeared to have a peculiarly stimulating effect upon endothelium in the African.

Miscellaneous Studies

65. The great variety of disorders encountered in the tropics has been a constant stimulus to medical men, giving rise to papers on many aspects of exotic disease. These reports reveal a breadth of interest which is in keeping with the traditions of medicine, and there is ample evidence that a lively scientific curiosity is being maintained in places where refined methods of investigation are seldom practicable. At a time when a trend towards extreme specialisation is only too obvious, it is satisfactory to note that colonial medical workers do not restrict themselves to a narrow range of subjects. The following paragraphs deal with some of the observations which have been recorded in connection with the less urgent problems of tropical medicine.

66. The widespread prevalence and economic importance of tropical ulcer have have led to many studies. Among these, papers by Smith

(1931-32-33) have emphasised the part played by symbiotic bacteria. Cultures of fusiform bacilli and spirochaetes obtained from Nigerian cases were shown to produce typical ulcers on inoculation into volunteers. These cultures showed no dissociative or cyclical changes. In Zanzibar, Connell and Buchanan (1934) made a survey of the disease and developed an improved recording system; they obtained good therapeutic results with a zinc-iodoform paste. Buchanan and Sanderson (1935) gave a further account of the use of this paste, which produced more rapid healing than could be achieved with the use of other local applications. A most comprehensive paper, covering all aspects of the condition as seen in Uganda, was published by Brown (1935). The classification, sex and tribal incidence, bacteriology, and biochemistry were thoroughly analysed, and the disease was shown to be associated with a diet which was deficient in protein and mineral constituents. The question of initial treatment was discussed by Stock (1945) in the light of Nigerian experience.

67. The question of pigment changes in the African skin was investigated in Uganda by Loewenthal (1934), who recorded some valuable notes on the variations produced by physical, chemical, and biological factors. Loewenthal (1934) also studied the disease known as "mossy foot", helping to clear up the pathology and systematic position of this peculiar affection. The most notable contribution from this worker was a review of the whole range of dermatological conditions found in negroes (Loewenthal (1936-37-38-39)). This review provides an authoritative account of the Ethiopian skin characters, dermatoses, and mycoses, and is consequently of much value to tropical practitioners.

68. In the field of mycology, the first East African case of *Rhinosporidium* infection was recorded from Uganda by Mowat and Hennessey (1941). This was a nasal infection, and several examples of the disease, both nasal and conjunctival, have since been described.

69. The bacteriology of water supplies in Tanganyika was studied by Burke-Gaffney (1932), whose paper on this subject provides an immense amount of information regarding the criteria on which potability may be assessed. This study included an examination of 2,500 cultures, many of which were anomalous strains of coliform bacilli. The association of these strains with excretal contamination was analysed, and the use of various presumptive tests was critically discussed. The investigation showed that these tests did not give consistently reliable results in the case of coliform organisms found in the tropics. Another notable example of laboratory research was a study by de Smidt (1939) of the bacteriology of lobar pneumonia. His 776 strains of *Str. pneumoniae* were classified and the findings correlated with the results of similar researches in South Africa. Methods of typing and vaccine production were also examined.

70. The serological examination of enteric fever was investigated in Palestine by Stuart and Krikorian (1934). These workers applied the method of recepto analysis, and were able to obtain considerable success in distinguishing the agglutinins produced by prophylactic inoculation from those produced by active infection. They also found that the production of "O" agglutinins, so important for effective resistance to infection, was favoured by heat-killed vaccines, and not by phenol-killed vaccines.

71. The subject of yaws was often investigated. Burke-Gaffney (1930) in Tanganyika reviewed the results of serological examinations (complement fixation and precipitin tests), and discussed the findings in yaws and syphilis. Transmission experiments were carried out by Lamborn (1936) in Nyasaland; he showed that *Musca sorbens* could convey the infection to volunteers, and furnished an account of the life history and bionomics of this fly. The treatment of yaws in the field is of special importance, and a large number of reports

on the effectiveness of different preparations of bismuth and arsenic have been published. The Rosenthal test in syphilis and yaws was examined in Nigeria by Smith and Elmes (1933), who also studied a modification of the Ide test (1945) and conducted filtration experiments with *Sp. schaudinnii* (1934). Among the numerous reports published by these workers from the Medical Research Institute at Lagos were papers on the properties of a neuro-testicular form of anti-variola vaccine (1931) (1933), Hodgkin's disease (1935), undulant fever (1941) cutaneous leishmaniasis (1944), and malignant disease (1947).

72. An important series of pathological reports has recently been published by Davies (1947), who has analysed some of the findings recorded at autopsies in Uganda over a period of some 17 years. Many interesting facts have already emerged, particularly in relation to incidence and tissue response to infection. Such studies are of great value, and point to the need for more observations upon the natural history of disease.

73. Tick-borne relapsing fever is endemic in various territories, and a number of papers dealing with its control have appeared from time to time. Among these, the successful use of paradichlorobenzene in eradicating ticks from native prisons in Uganda was described by Hopkins. A recent outbreak of louse-borne relapsing fever in Kenya was investigated by Garnham *et al.* (1946) who found that human disinfestation could be rapidly achieved with the aid of DDT. Many of the cases showed neurological symptoms and cardiac involvement. It was noted that no cross immunity occurred in animals as between *S. recurrentis* and *S. duttoni*, and that the Kenya spirochaete resembled *S. carteri* in pathogenicity.

74. Reports on surgical conditions encountered in Nigeria were published by Stock (1944-45-46), whose experience included cases of intra-mural colic abscess, Pick's disease (treated by pericardectomy), internal hernia with caecal adenoma, and collapse of the lung in porocephalosis.

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